



Urban Planning and Design Based on AutoCAD to Expand GIS Function

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Abstract. Computer-aided design is more and more widely used in urban planning and design. Compared with traditional manual drawing, it has the characteristics of easy modification, easy transmission and communication. The advantages of using AutoCAD to assist urban planning and design are introduced, as well as some techniques of AutoCAD software in urban planning and drawing, such as the application of layers, raster image references, tiles, table making, and virtual printing. First of all, this article detailed the content of urban master plan, the requirements of the results, and the relevant content of AutoCAD urban planning software, and analyzed the application development process and application content of AutoCAD urban planning software in urban master planning in detail. The example part takes villages and towns as an example, and takes the overall planning results as the basic goal. It compares the application of AutoCAD in each stage of the overall planning in detail, and demonstrates the specific ideas and steps of AutoCAD for planning, thereby analyzing the advantages in the overall planning and design process. The technical process of AutoCAD-assisted master planning was obtained.

Keywords: AutoCAD; urban planning and design; cartography; Raster Image Reference.

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1 INTRODUCTION

Computer aided design is a general term for using computer hardware and software systems to assist people in the overall design, drawing, analysis, and management of products or projects, Related research proposed by Azadeh et al. [1-3]. It is a comprehensive technology. With the rapid development of the computer software and hardware industry, computer technology is increasingly used in engineering design and drawing, and has achieved tremendous benefits that artificial design cannot match. von Richthofen et al. introduced that in the field of urban planning and design, the application of computer technology is also increasingly affected [4, 5]. Among

many CAD software products, AutoCAD has become the most popular and widely used CAD software with its accuracy, high efficiency, and easy modification. AutoCAD is a general-purpose computer-aided drawing and design software launched by the American company Autodesk. It is powerful, simple to operate, and easy to master. It has been widely used in gardens, machinery, architecture, electronics, aerospace, water conservancy, clothing, etc. [6, 7]. AutoCAD is very popular in the engineering world, not only as an application platform, but also as a software development platform. It has an intuitive user interface, pull-down menus, easy-to-use dialog boxes, and customizable toolbars. It has comprehensive graphic drawing functions, powerful editing functions, and three-dimensional modeling functions, and supports network and external references. Marschallinger et al. introduced that in urban planning and design, AutoCAD has become a common software for urban planning designers as an aided design tool [8, 9].

At present, almost all design units in China have adopted CAD technology, but there are large differences in application depth and application efficiency, mainly reflected in the application of professional software. After investigation by the author, the CAD software used by many planning departments is based on AutoCAD to organize human development; some units use pirated commercial software. In this way, CAD professional planning and design software generally presents the characteristics of multiple, chaotic, miscellaneous, and incomplete functions. The reasons are as follows: Although successful commercial professional design software exists, most of them are expensive and the maintenance and upgrade costs are unbearable. Organizing manpower to develop a full-featured planning and design software requires the coordination and cooperation of multiple people. It takes a long time and high development costs; the requirements for software developers, that is, to be familiar with the relevant professional expertise and workflow, and to have a high level of computer application. And, because most of these planning CAD systems are developed based on AutoCAD systems, and the development of urban planning, as well as the frequent upgrades of AutoCAD software itself, the original urban planning CAD systems do not meet the needs of current urban planning and design. In this case, it is necessary to develop an urban planning CAD system based on the AutoCAD environment familiar to current planners and solving specific problems encountered in planning and design.

The urban planning CAD system discussed in this paper is such a system. It focuses on solving practical problems encountered in urban planning and design. These problems mainly include the standardization of drawing (such as standard frames, standard layers, etc.), professional design of graphics library, customization of special line types of urban planning (such as sewage, rainwater line), and graphics storage. The solution of these problems can make urban planning and design more standardized, standardized, and fast, thereby greatly improving the efficiency and quality of urban planning, and promoting the active and healthy development of urban planning and urban construction.

2 AUTOCAD AND COMPUTER AIDED PLANNING AND DESIGN

2.1 Overview of AutoCAD City Planning Software

Weng and Kuo introduced that AutoCAD is an auxiliary design software generated with the rapid development of the computer industry and the market demand in the design field, Rotmans J et al [10]. Its main functions in the design field are data input storage and output, simple analysis and calculation, and very important image drawing. The most important role played by the planning scheme design is to realize the transformation of graphic expressions. In planning, the planning scheme is often first drafted by the planner by hand, and these sketches need to be converted into accurate planning drawings that conform to the specifications. This requires planners to use AutoCAD software to complete complex and heavy drafting work. By using common tools such as polylines, fills, offsets, chamfers, and labels, it can reduce the workload of planners while improving the accuracy and quality of drawing. With the development of urbanization and industrialization, urban planning has been increasingly valued by government departments at all

levels. Scientific and efficient planning is an important prerequisite for the healthy development of urbanization in China.

At the same time, the planning and design department also put forward higher requirements for software in this industry. Therefore, the development of the functions of the corresponding planning and design software must also keep pace with the times, facing the task of constantly upgrading functions and updating methods and ideas under new platforms and technologies. However, the research and development of CAD system is a rather complicated system engineering. The relevant planning departments have increasingly rich and complex requirements for CAD functions, and the requirements for intelligent and networked software are more and more urgent. Due to limited time and energy, some modules of this system are not yet perfect, and some aspects are only in the stage of research results. Compared with some successful commercial secondary development products, there are still gaps, some are incomplete and incomplete. The local needs to be further improved and improved in future work.

At present, the urban planning field mainly uses the "Xiangyuan Control Regulations" software based on the secondary development of the AutoCAD platform. This software is targeted for urban planning and development, and its corresponding functions are generated for various aspects of planning. Relatively complete, corresponding symbol libraries have been designed according to planning requirements to achieve the standardization of expression forms. At the same time, the vertical drawing of roads used in the master plan, the drawing of municipal pipeline networks, and the sub-plans and regulations in the control plan have been added. Indicators and other functions have high automation and clear and direct functions, and have quickly become the most important technical means in the field of urban planning. The development process of China's urban planning and design methods is shown in Figure 1.

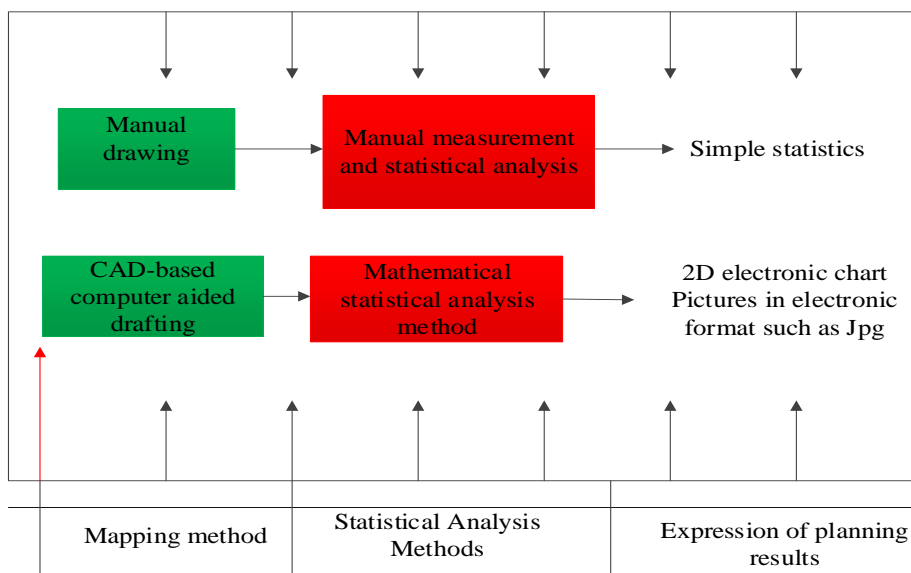


Figure 1: Development process of urban planning and design methods in China.

2.2 Related Contents of the Urban Master Plan

The urban master plan refers to the urban people's government's overall planning and comprehensive deployment based on the national economic and social development plan and the local natural environment, resource conditions, historical conditions, and current characteristics [6]. Social development goals, rational use of urban land, coordination of urban space layout, comprehensive deployment and specific arrangements within a certain period of time.

Urban master plans generally include three aspects: the master plan outline, the urban area system planning, and the central urban area planning. Generally, before preparing the master plans for large and medium-sized cities, the master plan outline is prepared as required, and its essential role is to provide a basis for the preparation of the master plan. As a programmatic document, formulate principles for urban master planning and guide important issues in master planning. The specific content is shown in Figure 2.

The planning of the city and town system is mainly to coordinate the development of the city and the countryside, determine the spatial layout and grade scale of each administrative area within the city, complete the guidance of major infrastructure construction, and formulate the goals of ecological environment protection. The central urban area planning, as a very important part of the overall planning, determines the spatial layout of urban construction land, sets urban development goals and functions, and gives play to the scientific, rational, and orderly arrangement of urban construction goals.

The results of the master plan are divided into text and drawings. The text includes the general plan text and the general plan description. The plan text is a document that sets out prescriptive requirements for the goals and content of the plan. It adopts the form of articles, which is normative, accurate, and conducive to specific operations. The compulsory contents of the plan include the delineation of the planning area, the area within the city that must be controlled for development, urban construction land, urban infrastructure and public service facilities, comprehensive urban disaster prevention, and recent construction planning. The plan description is a deep analysis of the plan text, and it is the specific implementation of the plan text content. The drawings include: city (county) area distribution map. A map of the status quo of the city.[7] Newly constructed cities and areas of urban development should draw engineering geological evaluation maps of urban land; city (county) region urban system planning maps; overall urban planning maps that show the various planning contents within the planned construction land; disaster prevention and historical and cultural heritage protection planning; plans for recent construction plans; plans for various specialties.

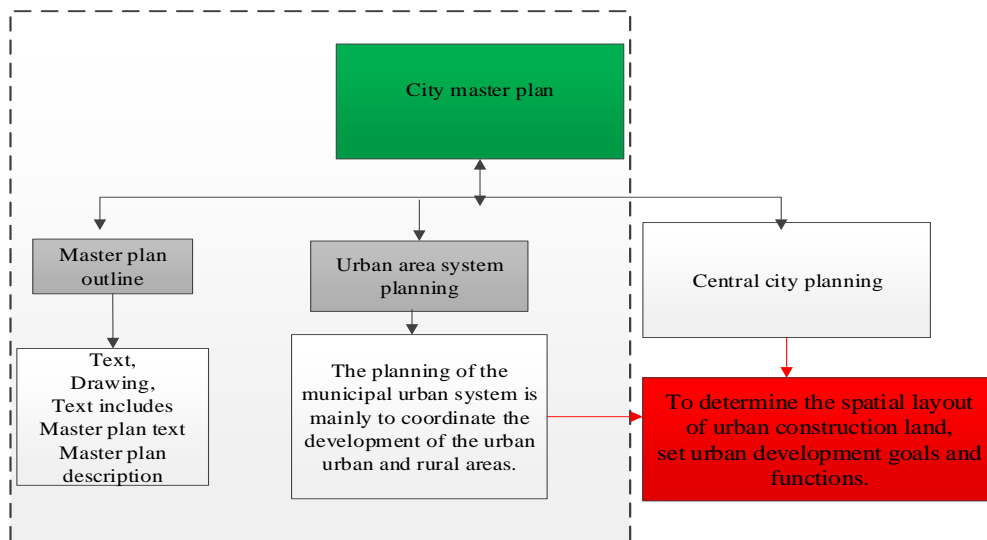


Figure 2: Contents of the urban master plan.

2.3 Application of AutoCAD software in Urban Planning

"Xiangyuan Control Regulations" software based on the secondary development of the AutoCAD platform is suitable for the design of urban master plans and regulatory detailed plans. It is mainly

used in land use planning, road system planning, municipal pipe network design, general floor plans design and make plans with a high degree of automation.

In the land use planning, the urban land classification and construction land use standards are adopted. After the land is filled, the parcel line and the filling classification code are automatically generated to generate a land use balance table and an indicator summary table that meet the standards. In road system planning, road red lines can be automatically generated according to road alignment and width settings, and the intersections to meet the turning radius can be completed [9].

2.4 Advantages of Using AutoCAD to Assist Urban Planning and Design

(1) Reduce workload and improve work efficiency

During the design phase of the urban planning scheme, the work of changing the drawings is very heavy, and there are often some changes in each demonstration. When using manual drawing, the designer must redraw each time. After using CAD drawing, because the basic sample is unchanged, only the position is changed or some local adjustments are made, which simplifies the work steps and reduces the workload. In addition, in most planning projects, some special planning scheme drawings such as infrastructure planning and road system planning can be modified based on the master plan. Therefore, AutoCAD can be used to assist in planning and designing and greatly improved work efficiency.

(2) Facilitate planning results management and file sharing

Utilizing the characteristics of the AutoCAD support network and external references, you can work together to complete the design of urban planning projects, and the electronic version of the planning results is conducive to management, is also conducive to batch copying and file sharing of results documents, and can output clear and accurate drawings an efficient design drawing tool software that manual drawing cannot match.

(3) Convenient to interact with other software

AutoCAD supports multiple file formats for output, and can easily interact with other software such as Photoshop, 3D Max, and so on. You can output CAD drawings as images, and then use Photoshop for post-processing to draw beautiful colorful flat effect drawings to express the design content intuitively. You can also import CAD graphic design solutions into 3D Max to make 3D scenes. Draw 3D renderings and make virtual reality scenes, Advantages of using AutoCAD to assist urban planning and design as shown in Figure 3.

3 SOME TIPS FOR AUTOCAD IN URBAN PLANNING CARTOGRAPHY

3.1 Application of Layers

Layer is a very important function of AutoCAD drawing, and it is the key to edit the image. When drawing more complicated graphics, each component of the graphics is often drawn on different layers, which is convenient for selection and display during editing. For the drawing of planning drawings, it is a good method to draw different types of entities separately according to layers. It can make the management of graphics more efficient and concise, especially when the amount of graphics is large and there are many types of entities. Thin and easy to edit. If you use filters to select entities, save layer states, or perform unified operations on the entities of a layer, good layering and layer setting habits will greatly help editing drawings.

3.2 Raster Image References

Urban planning and design generally need to be based on topographic maps of different scales. In addition to vectorized topographic maps generated using surveying and mapping methods such as total stations, the topographic maps that can be obtained in urban planning work are still drawings provided by the mapping department. Therefore, it is necessary to scan the raster image and then introduce it into CAD as a working base map. In addition, satellite pictures and remote sensing

images are often used as geographic base maps for planning and design. Therefore, the reference and processing of raster images is also necessary to use AutoCAD to aid planning and design. Note the following points for raster image references in AutoCAD:(see Figure 4)

(1) Introduction of Raster Images

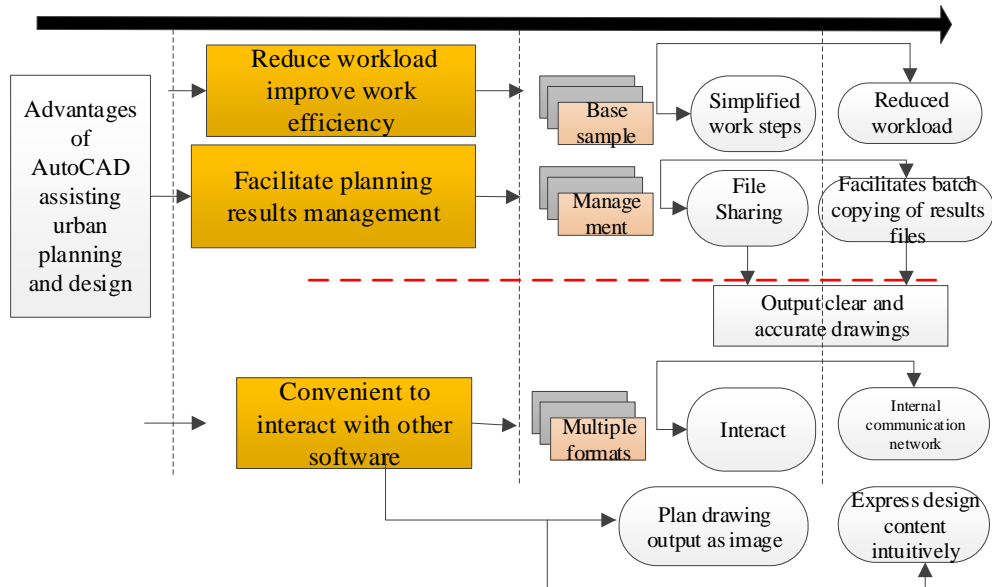


Figure 3: Advantages of using AutoCAD to assist urban planning and design.

You can use the “Insert / Raster Image Reference” command to introduce the raster image into CAD. In the “Insert File Dialog Box”, you can set the parameters such as the coordinates of the insertion point, rotation angle, and zoom ratio. Generally, you can choose the default parameters. If the topographic map is composed of multiple raster images, considering the number of screen refreshes and ease of use in AutoCAD, you can use other image processing software to stitch the raster images and then import them into CAD. After the raster image is introduced, it should be noted that the original file of the raster image and the AutoCAD file inserted in the raster image should be stored in the same folder directory, so that the problem of finding the base image cannot be avoided when moving the file storage location.

(2) Raster image scaling

Planning and design projects often need to output drawings of different scales. Therefore, it is necessary to make the raster image conform to the current project's drawing scale. This requires the topographic map to be scaled according to the drawing scale. When zooming, you can use the Reference option of the Scale command to make adjustments. Select the appropriate reference line in the raster image, calculate its length at the new scale, and then execute the scale command. After specifying the base point select the "Reference" option, and then specify the original and new lengths of the reference lines to complete the adjustment of the raster image scaling.[5]In addition, you can also use the align command to adjust the raster image, but you need to select the corresponding point as a reference during the operation.

(3) Raster image cropping and border settings

Raster images often have unwanted borders, or when only a portion of the raster image is needed, you can use the Modify / Crop / Image command in AutoCAD to crop the raster image to define a new boundary. The type of cropping for the new boundary can be "Rectangle" or "Polygon". The border of the raster image can also be closed. You can open or close the border of the image by executing the "Modify / Object / Image / Border" command in AutoCAD. After closing the border of

the image, the image cannot be selected and the display caused by selecting the raster image in the drawing can be avoided. The order is chaotic, which can avoid mis-operations such as stretching the boundary when drawing.

(4) Other settings for raster images

The "Modify / Object / Image / Adjust (Quality, Transparent)" command in AutoCAD can also be used to adjust the brightness, contrast, toning intensity, quality, and transparency of the raster image.

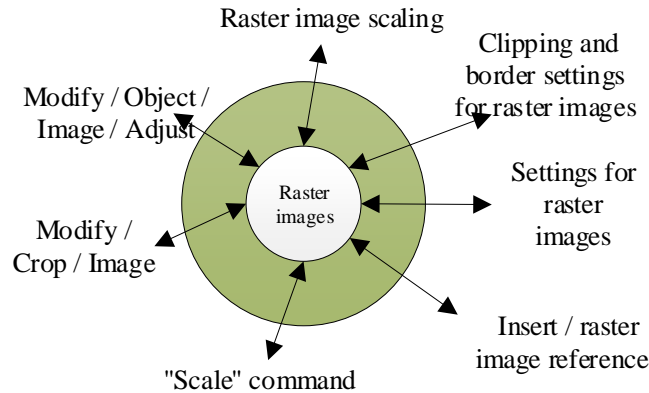


Figure 4: AutoCAD Raster Image Reference.

4 APPLICATION OF AUTOCAD IN URBAN PLANNING

The use of AutoCAD in planning is mainly to use its powerful drawing function to draw the current situation map, overall planning map, and various thematic maps on the topographic map. The overall idea is shown in Figure 5.

AutoCAD focuses on the expression of the scheme, and has certain obvious advantages in drawing various complex geometric and spatial graphic objects. In planning, its role is more reflected in improving drawing efficiency and enhancing expression effects. Produce drawings that meet specifications and design requirements.

In CAD software, the expression of planning information is basically the same as that of the above status information and the standard library in Xiangyuan CAD is shown in Figure 6. The main steps are as follows:

(1) Draw the road network structure. In traditional basic CAD software, first draw the center line of the road, and then draw the red line of the road by the offset tool according to the width of the road. Check the relevant turning radius requirements and then chamfer each intersection one by one. Xiangyuan control software only needs to determine the centerline of the road, and use the single-line turnaround tool to automatically generate the road network according to the set road width. For road intersections, select the width of the intersecting road in the intersection processing tab. The intersection is automatically processed according to the turning radius of the standard.

(2) Determine the layout of the land. The land use layout is the main expression of the overall land use plan in the planning results. It is used to guide the town construction to draw various types of land based on the status of the town planning standard GB50188-2007. Range line, then select the land range line to fill, and adjust the fill color to meet the land classification criteria. In Xiangyuan CAD software, after drawing the land use range line, use the land use tool to select the type of planning land for the corresponding category, auto-fill, automatic layering, insert the land classification code, and standard symbols to express the type of land.

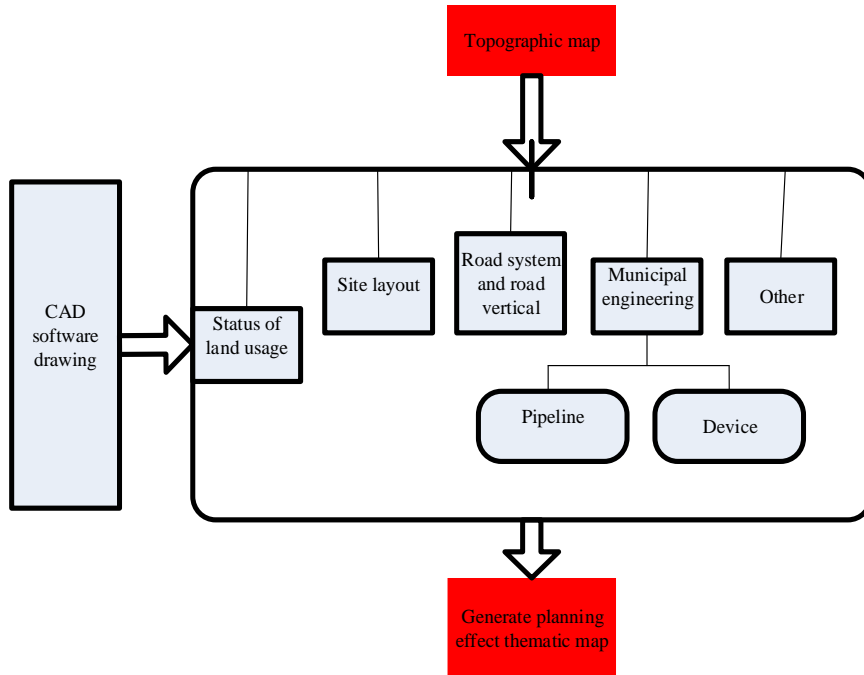


Figure 5: AutoCAD planning ideas for overall planning.

Substation	Reserve station	Party and government organs	Port	Feed pump station	switching station
Hospital	historical relics	Fire station	Square	Rail transit station	Freight yard

Figure 6: Standard library in Xiangyuan CAD.

Select all the filling objects to generate a land balance table, and adjust the various types of land according to the allowable change range of various types of land determined by the town planning standards.

(3) Formulate special plans. Road vertical planning: The road vertical planning requires the current elevation, design elevation, slope length, and slope and other information of the intersection. In traditional basic CAD software, you need to add tables based on the topographic map information to calculate the slope length and annotate after the slope. In Xiangyuan CAD software, use the single elevation command of road elevation, select each road intersection, mark

the design elevation separately, adjust the design elevation according to the current elevation, and ensure that the road slope is 0.3%-8%. Automatically generate slope, slope length. Comprehensive pipeline planning includes water supply and drainage engineering planning, power telecommunications planning, heating engineering planning, etc. In traditional basic CAD software, according to the planning standards, by offsetting the centerline of the road, adjusting the linearity, adding the direction and marking, complete planning; in Xiangyuan CAD, water supply, drainage, rainwater, and sewage are provided.

Quick drawing of water, electricity, telecommunications, heating and other pipelines. Taking drainage engineering planning as an example, the drainage volume is first predicted based on the water consumption. The sewage pipeline is laid directly underground. According to the topography of the planning area, the sewage is discharged to the sewage treatment field on the west side of the town by gravity flow, as shown in the figure below as shown, the drainage pipe network is drawn in a branch shape. There is a special pipeline tool in Xiangyuan. The line shape is fixed and the performance is more standardized. The arrows drawn indicate the sewage flow direction, shown in Figure 7.

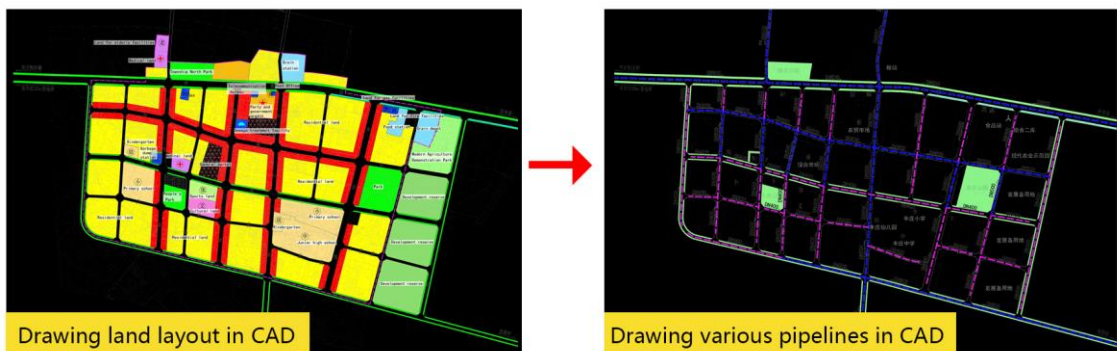


Figure 7: Layout of drawing land in CAD.

In the construction of urban basic geographic information system, the collection of spatial data of ground objects is one of the most important tasks. Obtaining spatial data directly from topographic maps is undoubtedly the first choice for various data collection schemes.

Because AutoCAD has very powerful graphic editing functions and high drawing efficiency, in the early map-making systems in China, AutoCAD was mostly used as a software development platform, and many large-scale topographic mapping systems also used AutoCAD as the basic geography of the city. The first choice for information system front-end data collection. Most of the geographic information data in the various scale topographic maps provided by the city's urban surveying and mapping department are stored in AutoCAD data format (DWG). The AutoCAD survey and drafting platform for the purpose of simple mapping has been relatively mature, and most of them have already fulfilled the drafting requirements on map schemes, which can meet the needs of digital mapping for surveying and mapping departments. However, with the wide application of GIS technology, GIS has convenient map display processing, geographic information query and strong spatial analysis capabilities. It is obviously superior to CAD technology in the management and application of digital graphics.

Because the conversion requirements of AutoCAD topographic map data to GIS data are not considered, the integrity and attribute characteristics of the symbols in the AutoCAD topographic map cannot meet the requirements of the GIS system. The conversion that comes with GIS software is only for graphic information. The complete feature will become multiple basic geometric figures, and the meaning of the represented feature is lost. Therefore, the digital

topographic map produced under AutoCAD cannot be directly converted into the GIS system. The conversion from CAD data format to GIS data format mainly includes four aspects:

- (1) Conversion of graphic elements;
- (2) The introduction of point, area and line related attribute elements;
- (3) the conversion of independent features and symbols;
- (4) Conversion of drawing notes.

Because the CAD data format generally does not consider the topological relationship of the data, and the GIS data must have the spatial data topological relationship so that it has the function of spatial data analysis, so how to obtain the corresponding attribute data according to the graphic data and make it relevant. The combination of spatial data of features is particularly critical.

Therefore, how can we use AutoCAD's powerful and efficient drawing function to easily draw topographic maps to improve the efficiency of data acquisition, and to make it possible to directly convert the data we have collected from AutoCAD format to spatial data in GIS topographic map format to avoid data waste of resources and repetitive labor, and improving the development progress of the system, have become important issues for our research.

5 CONCLUSION

AutoCAD is good at drawing, especially in road vertical and pipeline drawing. Xiangyuan CAD software developed with AutoCAD as a platform has greater advantages because it conforms to the relevant drawing standards for urban planning majors, providing a good drawing for overall planning. Precision and drawing efficiency. The shortcomings of AutoCAD are mainly manifested in statistics and analysis. In terms of statistics, in the overall planning process, according to planning requirements and specifications, it is often used to select certain elements to calculate the area according to the nature category. This is only what AutoCAD can do it can be derived from the balance table, classified query area, or selected by the planner one by one for the same nature elements, which not only increases the workload, but also easily cause the wrong selection or miss selection when selecting the elements; in terms of analysis, AutoCAD cannot make space analysis and management of data and attribute data plus. Because AutoCAD is only a basic software based on drawing, if it is only relying on it to complete the overall city planning, its task is more likely to fully express the form planning plan on the computer, and then the standardized output is on the drawing, basically a computer continuation of manual mapping.

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